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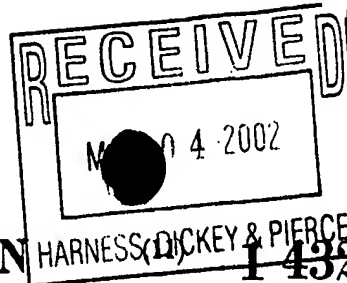
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# PATENT SPECIFICATION

1 432 372

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 (72) Inventor DONALD ALLAN YOUNG



## (54) SOLENOID OPERATED SWITCH ASSEMBLIES

(71) We, LUCAS ELECTRICAL LIMITED, formerly The Lucas Electrical Company Limited a British Company of Well Street, Birmingham, 19 do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

10 This invention relates to solenoid operated switch assemblies and, more particularly, though not exclusively, to solenoid operated switch assemblies for use in the control circuits of starter motors for motor vehicles.

15 According to the present invention, there is provided a solenoid operated switch assembly comprising a coil, a first armature, a second armature, a movable contact coupled for movement with the second armature, the first armature being slidable relative to the second armature axially of the coil between a first position in which it is axially spaced from the second armature and a second position in which it abuts the second armature, means biasing the first armature into its first position, at least one fixed contact, and means biasing the movable contact away from said at least one fixed contact, the arrangement being such that, when the coil is energised, the first armature is moved from its first position into and beyond the second position so as to effect movement of the second armature into a position in which the movable contact engages said at least one fixed contact whereby there is a time delay between energisation of the coil and engagement of the contacts, effected by movement of the first armature from its first position to its second position and movement of the first and second armatures to effect engagement of said movable contact with said fixed contact.

45 Preferably, the first armature takes the form of a sleeve which is slidably mounted on a rod of non-magnetic material coupled to the second armature, said rod mounting

rod and resilient means are disposed between the movable contact and an abutment on the rod to provide a resilient driving connection between the rod and the movable contact.

Most advantageously, a pair of fixed contacts are provided and the movable contact is arranged to bridge the two fixed contacts.

An embodiment of the present invention will now be described, by way of example, with reference to the accompanying drawing which is a longitudinal sectional view of a solenoid operated switch assembly according to the present invention.

Referring to the drawing, the solenoid operated switch assembly comprises a casing 1 within which is carried a coil 2 mounted on an annular former 3. Within the former 3 are mounted a first armature 4 and a second armature 5. The armature 4 takes the form of a sleeve which is slidably mounted on a rod 6 of non-magnetic material coupled to the second armature 5. The rod 6 extends axially through the coil 2 and between a pair of fixed contacts 7 to terminate on the opposite side of the fixed contacts 7 to the coil 2. The rod 6 carries at its end remote from the second armature 5 an abutment 8 against which one end of a spring 9 abuts. The other end of the spring 9 abuts a movable contact 10 which is slidable axially relative to the rod 6. A further spring 11 is disposed on the opposite side of the movable contact 10 to the spring 9 and is lodged between the movable contact 10 and a fixed partition 12.

The first armature 4 is slidable axially relative to the rod 6 and the second armature 5 between a first position in which it is axially spaced from the second armature 5 (as shown in the drawing) and a second position in which it abuts the second armature 5.

A further spring 13 is disposed between the first armature 4 and the second armature 5 and acts to move the first

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The solenoid operated switch assembly described above operates as follows:—

5 With the first armature 4 in its first position, and the coil 2 de-energised, the second armature 5 is urged into the position shown in the drawing and the movable contact 10 is urged out of engagement with the fixed contacts 7. When the coil 2 is energised, the first armature 4 is moved 10 from its first position into and beyond its second position against the action of spring 13. Since the armature 4 in its second position abuts the second armature 5 further movement of the armature 4 beyond its 15 second position causes the second armature 5 to be moved also. This movement of the second armature 5 causes the abutment 8 to be moved to the right as viewed in the drawing. Thus, a force is applied via the 20 spring 9 to the movable contact 10 in opposition to the force applied thereto by the spring 11. The arrangement is such that the force applied against the action of spring 11. The arrangement is such that the force 25 applied against the action of spring 11 is stronger than the spring 11 so that the movable contact 10 is moved into engagement with the fixed contacts 7 so as to bridge the latter. It will be appreciated 30 that movement of the second armature 5 does not occur until the first armature 4 has moved into its second position, thus there will be a time delay between energisation of the coil 2 and closing of the contacts 10 and 35 7, the delay being determined by the time taken for armature 4 to move from its first to its second position and the time taken for both armatures to move sufficiently to effect closure of the contacts 7 and 10. 40 De-energisation of the coil 2 causes the springs 9, 11 and 13 to shift the respective parts back into the position shown in the drawing. 45 It is considered that a solenoid operated switch assembly as described above provides a particularly convenient mechanism for providing an extended time delay between energisation of the solenoid coil and closing of the contacts, by comparison 50 with conventional solenoid operated switches.

#### WHAT WE CLAIM IS:—

1. A solenoid operated switch assembly comprising a coil, a first armature, a second

armature, a movable contact coupled for 55 movement with the second armature, the first armature being slidable relative to the second armature axially of the coil between a first position in which it is axially spaced 60 from the second armature and a second position in which it abuts the second armature, means biasing the first armature into its first position, at least one fixed 65 contact, and means biasing the movable contact away from said at least one fixed contact, the arrangement being such that, when the coil is energised, the first armature 70 is moved from its first position into and beyond the second position so as to effect movement of the second armature into a 75 position in which the movable contact engages said at least one fixed contact whereby there is a time delay between energisation of the coil and engagement of 80 the contacts, effected by movement of the first armature from its first position to its second position and movement of the first and second armatures to effect engagement 85 of said movable contact with said fixed contact. 90

2. An assembly as claimed in Claim 1, wherein the first armature takes the form of a sleeve which is slidably mounted on a rod of non-magnetic material coupled to the 95 second armature, said rod mounting the movable contact.

3. An assembly as claimed in Claim 2 wherein the movable contact is slidably 100 mounted on the rod and resilient means is disposed between the movable contact and an abutment on the rod to provide a resilient driving connection between the rod and the movable contact.

4. An assembly as claimed in any one of the preceding claims wherein there is 105 provided a second fixed contact and the movable contact is arranged to bridge the first mentioned fixed contact and the second fixed contact.

5. A solenoid operated switch assembly 110 comprising the combination and arrangement of parts substantially as hereinbefore described with reference to the accompanying drawing.

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Birmingham, 3.  
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COMPLETE SPECIFICATION

1 SHEET

This drawing is a reproduction of  
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